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REPORT OF THE PACIFIC NORTHWEST FOREST EXPERIMENT STATION FOR THE CALENDAR YEAR 1936

A part of the 520 acres on the Pringle Falls Experimental Forest where every tree has been numbered, classified, and log graded, preparatory to testing the silvics and economics of seven methods of selective cutting. The trees marked with an X would be removed under the new maturity selection system.

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Reports
Annual

Portland, Oregon
January 19, 1937

REPORT OF THE PACIFIC NORTHWEST FOREST EXPERIMENT STATION FOR THE CALENDAR YEAR 1936

Thornton T. Munger, Director

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HIGHLIGHTS OF 1936

During the year 1936 much time of the regular staff was devoted to planning and directing a large amount of development work on the five experimental forests. Our routine correspondence and contacts were greater than ever before, and the Station's facilities were very much sought by the general public, yet material progress was made on nearly every current project and notable achievement reached in some.

The more significant events of the year might be summarized as follows:

1. The launching of a new section of range studies at the Station, which has long been needed to round out the research program.

2. The completion of inventory, depletion and growth field work on the forest survey of Oregon and Washington after seven seasons, three of which were spent east of the Cascades.

3. The printing and distribution of five of the eight lithographed colored type maps resulting from the forest survey and the completion and drafting of two others. Also, the distribution of numerous descriptive and statistical releases resulting from the forest survey.

4. The Port Orford Cedar Experimental Forest established and its development begun.

5. Construction of offices, residences, workshops, bridges, fences, roads, trails, and fire lines, and installation of experiments on the experimental forests with emergency relief labor on a scale that could not have been done with normal appropriations for many years. Thus the Station has been put in a favorable position for the protection, management and use of these areas.

6. Analysis of the Burns working circle mill and forest valuation data, which resulted in recommendations for a radically new method in ponderosa pine cutting practice that has been named the "maturity selection system". This new method is already being tried out experimentally on 12,000 acres of national forest.

7. Two additional pine mills and their tributary timber supply were studied with a view to determining the degree of selectivity, if any, that would be most profitable in the long run on these particular operations.

8. Intensive training in statistical methods and the design of experiments taken by two of the staff.

9. As a part of the growth phase of the forest survey, completion of sampling the growth rates of all virgin types of eastern Oregon and Washington by taking 247 plots of 8 to 32 acres each.

10. A tree by tree valuation analysis made of seven plots of 60 to 100 acres each in mature ponderosa pine on the Pringle Falls Experimental Forest preparatory to their being cut to demonstrate silvical and economic results of seven forms of selectivity.

11. The establishment of an important series of stand improvement plots at Wind River to test methods of transforming a super-decadent forest into a producing stand of desirable species.

12. The collection of a large amount of data on the effects of partial cutting on the silvics, growth, and protection of Douglas fir forests.

13. The completion of a major manuscript in the field of forest measurements, namely, an interregional study of the growth and yield of even-aged ponderosa pine.

14. The development of a fire danger board to help protection agencies to get correctly a day by day appraisal of the fire hazard in a district.

15. Contributions in many forms, largely in cooperation with other agencies, toward a solution of land use problems, with special attention to tax delinquency, land classification, and zoning.

16. An analysis of the tax structures of four counties, with special reference to the influence of public ownerships, as a part of the nation-wide study of the contribution national forests should make to local government in lieu of taxes.

17. A series of eight all-day field meetings at as many centers of ponderosa pine logging activity, in cooperation with the Western Pine Association, for the dual purpose of acquainting local lumbermen and foresters with the most recent findings in forest protection technique and in the results of studies of the financial aspects of selective timber management.

PERSONNEL

The "regular" personnel of the Station has remained almost intact through the year; also most of the emergency employees paid from ECW funds and many of the clerical workers paid from ERA funds who were with us a year ago have continued and become increasingly valuable to us. The loss of Dr. Walter Meyer by resignation January 1, 1936, was reported a year ago. Mr. Percy Pratt, who was no longer needed as a check cruiser on the forest survey, was transferred July 1 to the Northern Rocky Mountain Experiment Station for similar work. Junior Forester Eric A. Anderson was added August 1 to the staff of the Section of Products to fill a vacancy that had existed for some months. Forest Ecologist G. D. Pickford was transferred from the Intermountain Forest

and Range Experiment Station late in the fall to take charge of the newly created Section of Range Studies.

The "regular" personnel now consists of the following:

Thornton T. Munger	Director
Horace J. Andrews	Senior Forest Economist
Axel J. F. Brandstrom	Senior Forest Economist
Sinclair A. Wilson	Senior Forest Economist
John E. Lodewick	Senior Silviculturist
Robert W. Cowlin	Asst. Regional Director, Forest Survey
G. D. Pickford	Forest Ecologist
Herman M. Johnson	Associate Forester
Donald N. Matthews	Associate Silviculturist
Paul D. Kemp	Associate Forest Economist
Leo A. Isaac	Associate Silviculturist
Floyd L. Moravets	Associate Forester
Philip A. Briegleb	Associate Forester
Ernest L. Kolbe	Assistant Silviculturist
William G. Morris	Assistant Silviculturist
Warren H. Bolles	Assistant Forester
Edward D. Buell	Assistant Forester
Eric A. Anderson	Junior Forester
June H. Wertz	Junior Administrative Assistant
Christina M. McPhail	Clerk-Stenographer
Frances Elliott	Clerk-Stenographer
Inga Frisvall	Clerk
Edna L. Hunt	Assistant Clerk-Stenographer
June E. Suckow	Junior Clerk-Stenographer
Elizabeth Straw	Under Clerk-Typist

Two members of the technical staff, Dr. Lodewick and Mr. Briegleb, were detailed to Washington, D. C., to take an intensive three months' course in statistical methods and the design of experiments and two others, Messrs. Matthews and Morris, devoted about a month to an interregional seminar on fire studies' technique.

On December 31 there were on our rolls 15 appointed temporary employees paid from emergency funds, nearly all of whom have been with us now 2 or more years. There were also several others, indicated by an asterisk in the list below, who were under appointment on our rolls a portion of the year.

William H. Beeman, Jr.	Jr. Forester
Roy C. Carlson	" "
Earl G. Dunford	" "
Stanton B. Hayward	" "
David H. Judkins	" "
Richard S. Kearns*	Asst. Forester
Wickliffe V. Litchfield	" "
Francis R. McCabe*	Jr. Forester
George S. Meagher	" "
Marion N. Nance	" "
Walter E. Pelto	" "
Boyd L. Rasmussen	" "
Clarence W. Richen	" "
William E. Sankela	Asst. Forester
George S. Schroeder*	Jr. Forester
Emily M. Sullivan*	Under Clerk-Typist
John C. Wilkinson	Jr. Forester
Charles H. Willison, Jr.	" "
Harry M. Wolfe	" "

In addition to the appointed temporary personnel the following skilled or clerical people are now on our Emergency Conservation Work rolls:

Elizabeth L. Baines	Under Clerk
Marion K. Becquet	" "
Grace J. Fredricksen	Asst. Clerk
Erna Jeppesen	Jr. Clerk
Don J. Shellhart	Under Clerk
George H. Jackson	Asst. to Technician
Morten J. Lauridsen	" " "

Under the Emergency Relief Appropriation this Station has had an allocation of 133 man-years, 17 in Washington and 116 in Oregon. From January 1 to July 15 the allotment (for wages of men and foremen, subsistence, tools, materials, etc.) was $83+ per man-month. Since July 15

it has been $73+ per man-month. Under this program a crew of about 28 computers, map colorists, and clerks has been steadily employed in the Portland office and a crew of from 10 to 40 laborers at each of the experimental forests for part or all of the year. These field crews have worked a short month, have been composed almost wholly of unskilled men (except for the ten percent allowed for foremen) and have been subject to considerable turnover, particularly in eastern Oregon.

At four of the experimental forests a squad of CCC boys, up to 25 in number, has been used part of the year largely on construction work.

During the summer 19 "student enrollees" at the CCC camps (mostly forest school underclassmen) were assigned at four of the experimental forests and were helpful assistants and incidentally were given training very valuable to them.

FINANCES

Since allotment of funds is made for a fiscal year beginning July 1, a statement of the financial setup for the calendar year cannot be made precisely. The regular appropriation for the Fiscal Year 1937 (commencing July 1, 1936) was $97,850, divided as follows: Forest Survey $34,000, Forest Management $26,650, Forest Products $14,300, Forest Economics $13,000, Range Investigations $9,900. This is $100 less than the preceding year. The Forest Survey allotment was cut $10,000 and a new allotment of $9,900 for Range Investigations was made.

This is some $69,450 less than for the Fiscal Year 1932. Emergency appropriations seemingly offset this decrease, but being uncertain

and temporary could by no means be used in the same way in carrying out a stable, long-time, technical program.

An Emergency Conservation Work allotment of $51,000 was made for the period July 1-March 31, 1937, approximately two-thirds of which was designated for the Forest Survey.

WPA funds in the amount of $92,340 were used by the station during the calendar year 1936 on our various ERA projects.

LIBRARY

The library has functioned along the same lines as last year. The acquisitions for the past year included 30 new books and 826 new pamphlets, reprints and manuscripts, and this growth practically fills present shelf and file space.

A marked improvement in the photographic files has been made by the librarian during the year by the reclassification of all photographs according to the subject-index system used for library material. Having each picture allocated to its proper class as well as cross-referenced to other subjects which it illustrates has greatly increased the usefulness of this collection. At this time there are approximately 3,500 photographs, of which 665 were added in 1936.

The addition by purchase of two good cameras during the year has materially aided staff workers in getting pictures to supplement other records and to illustrate field work under way.

EXPERIMENTAL FORESTS

A tract of 9,192 acres of virgin timber on the South Coquille River was set aside for research and demonstration and named the Port Orford Cedar Experimental Forest. This, the fifth of our experimental forests, rounds out the series representative of the major types of the region quite satisfactorily. Construction and development work on all five areas has been very active and much accomplished. The purchase of three tracts of private land with ERA funds gave us admirable headquarters sites at Cascade Head Experimental Forest and Port Orford Cedar Experimental Forest and safeguarded the Pringle Falls Experimental Forest headquarters.

A few miles north of the Pringle Falls Experimental Forest is a remarkable 80-year-old even-aged stand of ponderosa pine, which would be well suited for experiments in thinning and pruning and studies of growth and physical factors. It is proposed to add it to the experimental forest and with this in view a considerable area was cruised this past summer wherefrom to select the most desirable portion for research purposes.

The work on the experimental forests, done by CCC and ERA labor altogether, has been capital investment in headquarter buildings, roads, trails and fencing, in hazard reduction through slash disposal and fire line construction, and in maintenance and establishment of experiments.

The location and size of the several experimental forests are as follows:

Name	Locality		Area	Major forest type
	County and State	National forest		
Wind River	Skamania, Wash.	Columbia	10,185	Douglas fir
Cascade Head	Tillamook & Lincoln, Oreg.	Siuslaw	6,145	Spruce-hemlock
Pringle Falls	Deschutes, Oreg.	Deschutes	7,680	Ponderosa pine
Blue Mountain	Grant & Baker, Oreg.	Whitman	11,471	Ponderosa pine
Port Orford Cedar	Coos, Oreg.	Siskiyou	9,192	Port Orford cedar

To an increasing extent these areas are serving as demonstrations of forest practices and research methods. Wind River, for example, was visited by five large groups of forest school students this year beside various other technical groups and individuals.

Some of the development achievements of the year are as follows:

At the Blue Mountain Experimental Forest

A five-room combination office and residence, about finished.
Three miles of new road to Pogue Point built.
Establishing three permanent methods of cutting plots covering 160 acres.
Sale of merchantable timber cut for road rights of way.
Office work on type maps and timber estimates completed.
Collection of 100 herbarium specimens.
Improving and cleanup of headquarter site for buildings.

At the Cascade Head Experimental Forest

A 160-acre headquarters site fronting on coast highway purchased.
One 32-foot-span road bridge built.
Two thousand feet of woven wire fencing constructed.
A combination residence and office constructed.
A permanent water and sewer system installed at headquarters.
Two combination garage and shop buildings constructed.
6 miles of trail and a 2-stringer trail bridge built.
Three and one-half miles of new road surfaced.
Six miles of road partially graded and 2 miles more located.
One and one-half miles of telephone line constructed.
Experimental plantation of hybrid poplars made.
Plots to study release, thinning and pruning of alder established.
Fire hazard records and climatic records at three points taken.

At the Port Orford Cedar Experimental Forest

One 5-room office and dwelling, 3/4 completed.
One 140-ft., 2-span log stringer bridge, 3/4 completed.
One-quarter mile road under construction.

Approximately 4 miles of trail built.
Water system installed.
Headquarters site cleared of logs (approximately 3 acres).
1,765 acres cruised and mapped.
220 acres of experimental timber sale area (Port Orford cedar partial cutting) examined. Fuel type map made and damage to residual stand estimated.

At the Pringle Falls Experimental Forest

Pump house for water system built.
A 12-man crew house built.
A 3-car garage and storage building constructed.
Two miles of road rebuilt.
Three natural area plots of 10 acres each fenced.
Three miles of fire breaks along boundary constructed.
Two miles of roadside cleanup.
Three physical factor stations established and records kept.
Seven methods of cutting plots established, covering 520 acres and including some 20,000 trees.
Completing field work of an intensive survey and description of 3,840 acres in the proposed Lookout Mountain addition.
Establishment of a 480-acre slash disposal test area in which the piling and burning of slash in strips is demonstrated.

At the Wind River Experimental Forest

New office-laboratory built.
New septic tank and sewer system finished.
Headquarters buildings all repainted.
Old office rebuilt for use as guest cabin.
Log shelter built to house section of the Mineral big fir.
Cement vault and storehouse completed.
2 miles of horse trail built.
23 one-acre stand improvement plots established.
Over 30 kinds of tree seeds collected.
2 miles of Panther Creek road graded and graveled.
3 miles of roadside cleanup.
6 physical factor stations established and records kept.

SILVICULTURAL STUDIES

Forestation and Botanical Research

The periodic examination of the Wind River Arboretum was made at the end of the 1936 growing season. Although certain species were found to have suffered high losses from frost injury, especially during the severe winter of 1935-36, the majority of the trees have made exceptionally good growth during the last 5 years. With the continual addition of new groups, the arboretum now contains over 150 species and within a few years should include specimens of all the conifers that will grow in the Northwest on areas comparable to the Wind River valley.

An ever-increasing number of requests for the seed of native trees and shrubs to be used for arboretum, experimental planting and display purposes come to us as a result of the visits of foreign foresters to our woods and of American foresters to Europe. This year, seeds from 35 native species were collected, extracted and distributed by the Experiment Station to fulfill its part in this seed exchange with other research and educational institutions.

The 5 heredity plantations of Douglas fir established in 1915 and 1916 to determine the effect of the seed source on the growth of the progeny were reexamined for the 20-year measurement in 1936. The 2 plantations on the Mount Hood National Forest were measured for height alone, but the 3 others, on the Siuslaw, Snoqualmie, and Columbia National Forests, are faster growing and were large enough to permit measurements on both height and diameter. A progress report on this study is now being printed as a Department of Agriculture bulletin.

The plantations of 10 regional strains of ponderosa pine trees from widely different localities now growing in 6 plantations were notably benefited by the late spring and summer rains of 1936. Preliminary summaries of the records indicate that the best height growth since establishment in 1928 was made in 1936. These 10 regional strains are beginning to show differences in color, vigor, and habit of growth.

Phenological observations were recorded as in past years at one or more points on all national forests--at the Pack Demonstration Forest of the University of Washington, the McDonald Forest at Oregon State Agricultural College, and the Station's experimental forests.

Douglas Fir Silviculture

Silvicultural studies which have been in progress for several years at the Wind River Experimental Forest, notably those on germination, seedling survival, seed dissemination, and on grazing damage, were continued during 1936. Each year's data adds appreciably to the fundamental knowledge concerning natural reproduction in Douglas fir forests.

A study, completed in 1933, demonstrated that Douglas fir seed, if not eaten by birds, insects, and rodents, either germinates or decays within a year after its fall, whether under virgin timber or on logged-off land. This disproved the long accepted seed storage in duff theory at least as far as the Douglas fir seed itself was concerned. This past year replicated tests were started to determine the viability of the seed of the other important conifers of the region after having been stored in the duff for periods of 1, 2, and 3 years, respectively. The species now being tested, in addition to Douglas fir, include western

hemlock, western white pine, western red cedar, noble fir, Sitka spruce, Port Orford cedar, and ponderosa pine.

Stand Improvement. Throughout the Douglas fir region there are stands of overmature timber that are highly defective. Some of these will not be reached by cutting operations for years; others are so defective that no operator would ever log them. Meanwhile these stands are continually decreasing in value, while they are at the same time using up the entire productive power of extensive areas. During 1936 a project was started on several defective stands on the Wind River Experimental Forest to determine if stand improvement methods could restore them to normal growth conditions. The defective trees were cut or girdled on 23 one-acre plots distributed on 4 representative areas. For the next few years these plots will be reexamined. Changes in composition and in the kind and amount of reproduction will be noted; the release growth will be measured; the period necessary for girdled trees to die and decay will be determined; and the increase in fire hazard following cutting or girdling will be studied. This study should contribute much valuable data to the knowledge of stand improvement methods applicable to Douglas fir and its associates.

The study of the silviculture of partial cutting has been carried on for two field seasons. In the summer and fall of 1936 some valuable additions were made to the data previously gathered and the ground work was laid for obtaining more information regarding the future developments in the residual stands on partially cut areas. An effort was made during the 1936 season to secure a basis for these forthcoming observations by establishing a number of permanent sample plots. Nine

plots, ranging from 4 to 6 acres in area, were established and on each plot the trees over 6 inches in diameter were tagged and their descriptions recorded. Eight plots were established on proposed Forest Service timber sales and one on private land. A semi-permanent plot, established during the 1935 field season, was reexamined, tagged and added to the list of permanent plots. The areas were selected as representative of the Douglas fir and Sitka spruce types of western Oregon and Washington.

In addition observations were made on temporary strips taken at random in ten partially cut areas to secure information concerning logging damage, windfall, reproduction, fire hazard, and growth in the residual stand.

Ponderosa Pine Silviculture

The problems of establishing or reproducing forests and developing them to full production are inseparably interdependent with the methods of logging, intensity of protection and grazing and other forest practices. This condition is especially true in the management of the overmature ponderosa pine stands that contain trees widely different in value and in insect susceptibility as well as in growth rate and vigor. An outstanding contribution to ponderosa pine silvical knowledge was made during the year by the local forest insect station of the Bureau of Entomology in their published findings on the relative susceptibility of ponderosa pine to bark-beetle attack. In this investigation a new tree classification for ponderosa pine has been developed which has been adopted by this Station and will undoubtedly be used in many pine management practices and investigations. As useful as this classification will likely be to future work, more significant are the conclusions that

"silvicultural management of our ponderosa pine forests should eventually lead to the solution of present pine beetle problems. Improvement of growth conditions and the reduction of mortality are such closely related phases of timber management that the measures necessary to accomplish one are certain to have a beneficial effect upon the other. The types of trees which should be cut in order to improve growth in the residual stand are also those which should be removed in order to reduce mortality".

Likewise investigations in logging economics (described in a later paragraph) have added to our silvical knowledge during the year. These studies are not as yet completed but they already give assurance that the "maturity selection system" of cutting in which only a light cut is made of the financially and biologically mature trees is feasible. Adoption of a light cutting system will revolutionize almost every phase of the management of ponderosa pine timberlands. To clarify the conception that underlies this new system, a mimeographed report was issued under the title "Basic Considerations in the Management of Ponderosa Pine Forests by the Maturity Selection System".

Marked progress was made in the establishment of new permanent sample plots and in checking growth and mortality of cut-over areas. On the Pringle Falls Experimental Forest 7 plots were laid out to provide a field demonstration of various intensities and methods of cutting for best silviculture and highest ultimate money returns. These plots cover an area of 520 acres and contain some 20,000 measured and classified trees.

On the Blue Mountain Experimental Forest two 40-acre and one 80-acre permanent plots were established in an area selectively cut over in 1918 to furnish a basis for determining the growth and survival of residual trees on heavily cut areas. The records taken on these experimental plots were augmented by a cruise of residual trees on some 12,000 acres of cut-over lands within the Malheur National Forest. The situations revealed by these data, as well as those taken on the older sample plots, are being made available to public and private agencies in determining the silvicultural requirements that must be met to promote continuous production on ponderosa pine timberlands.

Fire Studies

In fire control circles 1936 was outstanding for its several important conferences. At the Spokane Fire Control Conference in February recent developments in equipment were discussed at length and research men presented the current results of their work. In late summer this region was host to a group of fire studies men from the East and South; Matthews and Morris accompanied them to a meeting at the Shasta Experimental Forest where many important fire studies problems and policies were discussed to the mutual advantage of all present. In November and December Matthews represented the Station on the special fire control committee which met in Washington to formulate a comprehensive outline of fire control planning. In addition to inspiration, these meetings afforded an invaluable exchange of ideas which, in addition to coordinating our program of fire studies with the program of other stations in all parts of the country, will undoubtedly strengthen this rather new field of fire research from this time forward.

The outstanding new work of the year was the start made toward development of a fire danger rating board or meter for use in Oregon and Washington. Through the cooperation of the Regional Forester's Office one man has been assigned to the Station who has been devoting his entire time to this project. The object is to provide a practical scheme by which the measurements of fire danger factors, fuel inflammability, wind, etc., made at the fire danger stations in the region can be combined to show the class of day and the appropriate administrative action. Experimental fire danger boards with four classes of each factor shown by different colors were put out on all the national forests and aroused considerable interest. This project is being pushed at the present time in order to provide a complete fire danger meter and display board for field use in the immediate future.

Fire problems of partial cutting were studied, particularly an area of experimental cutting of Port Orford cedar and in connection with the study of the silvicultural effect of partial cutting in the Douglas fir region.

Man-power production of held line in fire fighting was studied intensively on going fires, dummy fires, and fires of previous years. The results indicate that variations in forest cover have a direct influence on the man-power output in fire fighting. Recognition of this fact is increasing the interest in mapping fuels by resistance to control and rate of spread classes. Preliminary work on such maps, commonly called fuel type maps, has progressed during the year. The small plot method of analyzing fuels has been developed further. Considerable attention

was devoted to fuel and weather relationships and to the effect of variations in degree of exposure on the moisture effect of forest fuels.

Preparation and revision of the specifications of the fire danger station equipment and haze meters developed at the Station has received a great deal of attention during the year because of the growing interest in these instruments. The results of field tests have been carefully watched in order to improve the durability and accuracy of the instruments. Specifications have been rewritten so that advantage can be taken of quantity machine production. A rough check indicates that there have now been put into use approximately 900 of our wind gages, 450 wind vanes, 475 fan psychrometers, 600 hazard indicator stick scales, and 206 Byram haze meters. In general somewhat over half of these instruments are used by the Forest Service in Oregon and Washington and the remainder are scattered over the entire country with two complete fire danger stations and eight haze meters used on the other side of the world in Tasmania. It is hoped that promotion of these low cost but serviceable instruments will not need to be carried much farther by the Station before manufacturers will become interested in meeting the very evident demand.

All permanent and temporary members of the fire studies staff spent considerable time on going fires during the late fall fire season.

The visibility studies conducted by McArdle and Byram in former years provided the subject matter of the principal publications released during the year.

FOREST MENSURATION

Dr. Walter Meyer, who was in charge of this section until he resigned the first of the year, has been very generous in devoting as much time as he could spare from his classes at the University of Washington to finishing up certain tasks which he could do better than anyone else. As a result of his spending much time on the work of this Station at various times throughout the year, the manuscripts that were unfinished when he resigned have been concluded and have been or will be issued largely under his authorship.

Sitka Spruce-Western Hemlock Yield Study. Checking and editing of the manuscript resulting from this range-wide yield study was completed and this report is now in galley proof of a forthcoming U.S. D.A. technical bulletin. This addition to the Station's series of standard yield tables for the important timber types in the region reveals that the spruce-hemlock type exceeds in yield the rapid-growing Douglas fir on comparable sites by 20 to 60 percent, depending upon the length of rotation and standard of measurement selected. To disseminate generalized information pending issuance of this publication a review of the manuscript was prepared and published in the Pacific Pulp and Paper Industry.

Even-Aged Ponderosa Pine Yield Study. During the year a manuscript for a U.S.D.A. technical bulletin has been prepared, checked, and edited, based upon an interregional yield study of even-aged ponderosa pine stands, the computations for which were finished last year. Although this species most commonly grows in uneven-aged forests, it also

thrives in even-aged stands on favorable situations. The manuscript points out that the extent of even-aged pine stands is much greater than has been estimated in the past. In only ten counties of eastern Oregon and eastern Washington for which forest survey statistics are at present available more than 1,340,000 acres of ponderosa pine stands have been classified as second growth. This standard yield table provides the basis for estimating growth of such stands throughout the range of the species.

Growth Phase of Forest Survey-Douglas Fir Region. Results of the growth phase of the forest survey were compiled, summarized, briefly analyzed, and published in mimeograph form in a report entitled "Forest Growth in the Douglas Fir Region".

Sustained yield possibilities and idealized cutting budgets leading to this objective were computed for each of the forest units of the Douglas fir region and for the region as a whole, as a means of analyzing the potentialities of the Douglas fir region for the forest survey report. The computations indicate that the present total saw-timber volume of the region is only 3 percent less than the normal volume. However, actual departure of the existing forest from normal is tremendous. In the normal forest the entire area is occupied by growing stands; in the Douglas fir region only 38 percent of the area is occupied by such stands, 45 percent is occupied by non-growing virgin timber, and 17 percent is deforested. And of the present area of growing stands only about 41 percent is adequately stocked. Basic data from the inventory and growth phases of the forest survey were used in these computations.

Growth Phase of the Forest Survey--Ponderosa Pine Region. During the field season of 1936 two growth crews of three men each completed the field work of sampling growth of virgin stands in eastern Oregon and eastern Washington. Altogether 247 independent samples of from 8 to 32 acres each were taken, representing all virgin types throughout the region. The basic computations on about two-thirds of these samples have been completed. The primary function of these growth samples is to provide a basis for making the growth estimates in connection with the forest survey of the ponderosa pine region. Additional analysis of the samples is anticipated in a further study of tree and stand growth in order to provide a basis for making growth estimates on specific timber areas merely from such stand tally, stand structure, and site information as may be collected by a timber cruise.

In order to evaluate in terms of normal yield table stocking the stocking of areas as recorded by forest survey type mappers, a study of the application of the Douglas fir and the new ponderosa pine yield table to east-side even-aged stands was initiated near the end of the field season in 1936. In addition to serving the primary purpose for which it was designed this study will test the applicability of the Douglas fir table to east-side upper slope types, and of the new ponderosa pine table to extensive actual even-aged stands.

Growth Cycles in Ponderosa Pine. The study of growth cycles in ponderosa pine was extended to new areas in eastern Oregon and eastern Washington, using the increment cores collected for the growth phase of the forest survey. Individual ring measurements of some 400 increment

cores have been made by ERA workers. The measurements were made with a microscope micrometer we have had manufactured for the purpose. The instrument reads to 1/100 of a millimeter. Preliminary analysis of these data indicates that during abnormal periods gross growth may for several decades depart widely from the normal. The problem of determining the periodicity of these fluctuations with the objective of predicting them is yet unsolved.

Growth of Douglas Fir in Even-Aged Stands. Periodic remeasurements were made on 11 Douglas fir growth permanent sample plots this year. Data from these plots are of increasing value and interest as more records accumulate. Several of the plots were established 30 years ago, and hence afford valuable comparisons between actual growth and normal growth for a large part of a rotation. Throughout this period the various plot values have adhered remarkably closely to normal yield table figures.

During the year coordinated height curves for even-aged stands of Douglas fir were distributed in a mimeographed publication. By use of these curves the field work of estimating tree heights in even-aged stands of the species is reduced to merely determining site and age of the stand. The curves were prepared last year from more than 8,000 measurements of tree heights taken in connection with the Douglas fir yield study. A description of the technique employed in their construction and directions for their use are included in the publication.

Growth in Partially Cut Stands-Douglas Fir Region. Field data for use in this study have been collected from stands partially logged as a part of the study of silvical aspects of this type of cutting in the Douglas fir region. Nine permanent sample plots averaging 5 acres

in area were established during 1936 in selectively cut stands or in stands to be so logged. They will in time contribute to our present meager knowledge of growth in such stands.

RANGE STUDIES

So short a time has elapsed since the range studies section was manned that effective plans for the 1937 field season have not as yet materialized. Tentative plans contemplate exploration for future work centers; gathering information on important vegetative types, species, palatability and forage yields; and studies to improve existing methods. Close cooperation will be offered the Regional Forester's office of range management in organizing and conducting field work on the 1937 AAA soil conservation project in order that valuable information may be obtained on plant cover, present stocking, and proper grazing capacity of privately owned ranges.

Until the field season opens, efforts will be made to bring analysis of the effects of grazing cut-over Douglas fir lands up to date. A complete check of the Region Six herbarium, which includes revising nomenclature and constructing a standard plant symbol list for the region, is also planned.

FOREST PRODUCTS INVESTIGATIONS

Ponderosa Pine Mill Production Studies. Mill production analyses, resumed last year, were carried forward in 1936 at an accelerated pace. A study of 1,000 logs was made at the Ewauna Box Company mill in Klamath Falls, and another of 800 logs at the plant of the Kinzua Pine Mills Company, Kinzua, Oregon. The former was designed to give log recovery values where an appreciable proportion of the output is box lumber. Both studies were undertaken cooperatively with the companies which are interested in the feasibility of economic sustained yield operations. The descriptive log grades developed during the Edward Hines Lumber Co. study in 1935 were used in the two studies this year. Preliminary analyses indicate that the log value classes were clearly defined and were in line with values obtained in 1935. Another interesting fact is that the manufacturing cost curves for the three large mills varied by only a few cents within any of the log diameter classes. The data resulting from these mill analyses are basic to the determination of tree values, which in conjunction with logging cost data and silvicultural considerations, should determine the most permanently desirable method of ponderosa pine management.

Douglas Fir Mill Production Studies. Nearly 2,000 second-growth Douglas fir logs were studied in four mills in the Willamina district of Oregon. The studies were designed to supplement log grade descriptions previously proposed, and to obtain further data on a method of rating efficiency in small sawmills. The data obtained early in the field season have not been compiled.

Statistical Studies. The gathering and compiling of the annual production, distribution and price data of various forest products occupied a large part of one man's time. The lumber, lath, shingle and log production census for 1935, in cooperation with the Bureau of the Census was completed in June. The 1935 lumber cut of Oregon and Washington amounted to 6,597,764 M feet or over 34 percent of the nation's production. The cut of these States exceeded that of 1934 by 21 percent. These data were reworked in various ways to supply the many requests from State and government agencies, trade organizations, chambers of commerce, planning councils, banks, bond houses, companies and individuals. Statistics on log and shingle prices, and on the prices of various oils, barks, balsams and other minor forest products were summarized for distribution. Export data on logs, lumber, and other wood products were compiled.

Farm Timber. A study of the importance, marketing, and management of farm timber and farm timber products was continued. In 1930 there were 2,800,000 acres of farm woodland and woodland pasture in the Douglas fir region of Oregon and Washington, which acreage had increased to 2,950,000 acres in 1935. The first article in the series showing the value of these woodlands to the individual and the community was published in the three principal farm papers of the Pacific Northwest. It is expected to continue the study in 1937 with special emphasis on the management and marketing phases.

Minor Species Studies. Although occurring only in comparatively small quantities the hardwoods of the Pacific Northwest are of considerable importance to certain of our industries. Studies dealing with

properties and uses of red alder, bigleaf maple, Oregon white oak and northern black cottonwood have been completed and the results published. Additional data are being accumulated on other species, particularly Oregon ash.

Miscellaneous Studies. The Pacific Coast Logging Company showed such an interest in the development of portable, power-driven saws for felling and bucking that a study of all available information on this subject was begun. So far the information gathered includes descriptions of models now on the market, time studies, practical logging experience and historical material. These accumulations will be condensed and placed at the disposal of the loggers.

Two years ago, plans were laid for making a periodic examination of selected Anaconda paste-treated poles installed on the national forests in Region Six. At that time half of all the lines so treated were examined. The remaining half were inspected during the summer and certain lines tentatively chosen for intensive periodic examination. It was noted that poles not treated carefully at ground line sometimes showed decay when others to which the paste had been applied in accordance with the latest specifications were apparently sound.

A long-contemplated survey of the status of kiln-drying in the Douglas fir region was consummated during the year. The study was designed primarily to provide a sound basis upon which to plan studies leading to more universal adoption of artificial seasoning. Under ECW funds it was possible to obtain the services of a man experienced in dry kiln installation and operation. The survey covered 144 plants in which there were 990 kilns or drying units of various types including 86

shingle kilns and 13 common or dimension drying schedules and proportion of annual production artificially seasoned. It is interesting to note that there has been a marked swing from national-draft to forced-draft kilns, that there is a tendency to develop portable or yard driers for dimension stock, that a larger proportion of the cut is being kiln-dried, and that there is a quite general recognition of the importance of artificial seasoning among progressive operators.

Flow maps showing the distribution of lumber produced in Oregon and Washington for the even years 1922 to 1934 were prepared in cooperation with and issued as a report of the Oregon State Planning Board. The maps present in graphic form the change in total distribution from year to year. The data indicate that the lumber industry of the two States is dependent largely upon outside markets, only one-fourth to one-third of production being consumed at home. In foreign markets western woods have maintained their competitive positions except where adversely affected by trade agreements. Domestic markets have been maintained and even augmented at the expense of competitive woods wherever rail or water rates have been favorable.

FOREST SURVEY

1936 was a banner year in the history of the forest survey. Accomplishments were many and varied. Six years of steady progress resulted in the publication and dissemination of much valuable information.

Compiling inventory statistics and preparing 1-inch-to-the-mile type maps for eastern Washington and Oregon counties mapped during the 1935 field season occupied the early part of the year. This work resulted in the publication of type maps for Harney County, Oregon, and

Okanogan, Ferry, Stevens, Spokane, and part of Lincoln County, Washington. As soon as the computations were complete for a county a report was prepared consisting of tables and graphs giving the basic inventory statistics and a short text discussing the forest situation in the county. Commencing in February reports were issued in rapid fire order for Klamath, Jefferson, Wasco, Lake, Deschutes, and Harney Counties, Oregon, and Klickitat, Yakima, Chelan, Kittitas, Columbia, Garfield, Asotin, and Walla Walla Counties, Washington.

The publication in final form of the lithographed forest type maps of northwest, southwest, and southeast Washington and northwest and southwest Oregon was a major accomplishment. These maps are the first of this kind ever attempted on such a large scale in the United States. They have been enthusiastically received and 2,500 copies have been distributed to public, quasi-public, and private agencies. Final proof copy of the map of southeast Oregon was received and checked and is now in Washington, D.C., awaiting final printing. The sheet for northeast Washington is in the final stage and proof copies should be available early in 1937. This leaves only one sheet, the northeast quarter of Oregon, with any considerable amount of work yet to be done and in December a start was made on this sheet. It is expected that first drafts of this quarter will be submitted to the printer in February 1937.

The report of the growth phase, Douglas fir region, was published in mimeographed form as Forest Research Notes No. 20. All other efforts on the Douglas fir region were concentrated on the only remaining big part of the project, namely, the writing of the descriptive and analytical regional and unit reports; five chapters of the regional report are complete except for editing and two chapters done in first draft,

leaving one chapter to be written. The eleven unit reports which had previously been prepared in rough draft were revised and condensed.

During the year all field work on the growth and fire depletion phases in eastern Oregon and eastern Washington was completed. A substantial start has been made on the compilation and analysis of these data.

Field work on the forest survey of Oregon and Washington has been completed. At the beginning of the 1936 field season the Blue Mountain area in northeastern Oregon had not been covered. As soon as weather permitted field work commenced and the assignment was completed late in December when the last of the 14 type mappers returned from the field.

As field work progressed in northeastern Oregon basic computations and preparation of county type maps kept step. One-inch-to-the-mile type maps were published for Crook, Wheeler, Morrow, and parts of Union and Umatilla Counties, and work on Wallowa, Grant, and Baker Counties was so far along by the end of December that they should be completed very early in 1937. When the maps for these three counties are finished, there will be available detailed 1-inch-to-the-mile forest type maps for every forested county in Oregon and Washington and these are the only two States in the Union having complete sets of county forest type maps.

In the spring a set of freight rate maps for the Douglas fir region were prepared in the form of large tracing cloth sheets which are superimposed over the regional type maps so that the various timber types show through the tracing cloth. On these maps (which are not for public distribution) are located all main and branch line railroads,

independent common carriers, and logging railroads. By a series of colored figures and letters the freight rates on logs by rail and water are shown from all points in the forest areas to the major manufacturing centers.

An increasingly large amount of time has been consumed in filling special requests for statistical and map data, while at the same time the calls for regular published statistics and map data have continued. During the year the supply of many of the survey statistical pamphlets was exhausted and additional supplies were mimeographed. Even though a large number of the 1-inch-to-the-mile county type maps had been requested in 1933, 1934, and 1935, the distribution of the lithographed regional type maps created a further demand for these detailed maps. The survey is recognized as the authority for basic inventory, growth, and depletion information on the forests of Oregon and Washington and the steady and continuous use made of the Survey's findings by both public and private agencies and individuals too numerous to mention has been most gratifying.

LOGGING ECONOMICS

Selective Timber Management in Ponderosa Pine. The major accomplishment in this project during the past year was the completion of the comprehensive case study of selective timber management for the Burns working circle on the Malheur National Forest of eastern Oregon. Participating with the Station in the planning and execution of this study were the regional forester's office and the firm of Mason and Bruce, consulting foresters who represented the Edward Hines Lumber Co.

A notable feature of the study is that it brings together and correlates the results of years of research in several different projects that have been conducted at this Station. Practically every section of the Station has made substantial contribution by furnishing data needed either in the silvicultural or the economic phases of the study.

From an analysis of the study data was evolved a system of light selection which is now being tried out on an area of 12,000 acres, where logs are being taken out at the rate of nearly half a million board feet per day. Since it is based on the financial and biological maturity of the trees this system, as discussed in a previous paragraph on pine silviculture, has been named the "maturity selection system".

Under this system in this particular area about 40 percent by volume, comprising the most overmature, and generally high-value elements of the stand, is being removed in the initial cut. This is, indeed, a very radical change from the present system of standard forest service selection, under which about 85 percent of the stand volume is removed.

On the basis of the study data the proposed system promises highly gratifying results both with respect to immediate and future returns. Particularly striking are the results indicated for the first cutting cycle, which under the proposed system would extend over approximately 30 years. During this period the indicated net stumpage realization per M board feet is nearly doubled, the volume growth of the reserve stand nearly trebled, and the corresponding value growth about quintupled, in comparison with the corresponding results under the present system of cutting. As a result of this increase in growth the volume of permanent

growing stock available for sustained yield production 60 years hence would be increased by about 30 percent. Another permanent advantage would be the substantially higher unit value of the timber produced.

The area involved in the Burns Working Circle Study embraces about one million acres, most of which is national forest land. If the results of the present large-scale cutting experiment confirm the conclusion of the study, it is of greatest significance to the management of all ponderosa pine forests which are or can be put on a sustained yield basis; for in principle, the advantages of light selection apply throughout the ponderosa pine region, although the details of selection to fit specific conditions need to be worked out through careful study for each individual case.

For privately owned timber the question of ownership, length of operation, and other factors introduce problems of management not encountered in dealing with national forest timber. Two important case studies, involving the problem of management of privately owned timber were started last summer and are now in the process of analysis. One of these is the study of the operations of Kinzua Pine Mills Co., Kinzua, Oregon; the other of the Ewauna Box Company, Klamath Falls, Oregon. Field work for both studies has been completed. This has consisted among other things in detailed production cost studies of the milling and logging operations, of which the mill study phase was done by the Section of Forest Products as described elsewhere in this report. The woods phase includes studies of logging costs and operating methods and also a comprehensive sample plot study of the forests, in the course of which nearly 3,000 sample trees were measured, classified, bored for ring

counts, and log graded. From these data will be determined the stand structures of the forest, the volume and value growth of trees of different diameters by tree classes, present and future monetary returns, and present and future growth obtainable under different forms of selective cutting.

As a part of a Station project designed to demonstrate silvical and economic results of different forms of selective cutting approximately 20,000 tagged and numbered trees were log graded on several large experimental plots that had been laid out by the Section of Silviculture on the Pringle Falls Experimental Forest. These data will be used as a basis for a tree by tree valuation preparatory to marking the timber under seven different forms of selective cutting.

Motor Truck Log Hauling Study. The possibilities of adaptation of logging methods to better fit the needs of lighter cutting and continuous management have been given close attention both in connection with last year's production cost studies in the ponderosa pine region and in previous similar studies in the Douglas fir region. A most promising recent development is the rapidly growing use of motor trucks either as a substitute for or as a supplement to the railroad haul. New methods of road construction and improvements of motor trucks and auxiliary hauling equipment are being introduced on a large scale both in the pine and the fir region and bid fair to greatly advance the possibilities for better and more intensive forest management. So rapid has been this development that the study of motor truck hauling costs made by Rapraeger of this Station in 1933 is now largely out of date. In order to provide up-to-date information on this important new subject

a study of truck hauling was started last year. This will provide data on the cost of truck hauling on various types of roads for different sizes and species of logs.

Selective Timber Management in the Douglas Fir Region is the title of a report by Kirkland of the Washington Office and Brandstrom of this Station, which was published last spring under the auspices of the Charles Lathrop Pack Forestry Foundation. This is a searching, thought-provoking analysis of the economic aspects of selective timber management which is having a very stimulating effect on our forestry thinking in this region. It is mainly the result of selective logging and production cost studies conducted at this Station since 1931.

Preliminary arrangements have been made with the West Fork Logging Company, Mineral, Washington, and the Grand Rapids Timber Company, Seaside, Oregon, for cooperation in experimental selective cuttings and related studies bearing on the possibilities of sustained yield operation. Owing to the pressure of work in connection with the ponderosa pine studies, no field work has been started yet on these projects.

Cooperation with the Southern Experiment Station on Tractor Study. Last spring when the Southern Forest Experiment Station started a comprehensive investigation of the possibilities of tractor logging on the operation of the Crossett-Lumber Company at Crossett, Arkansas, Brandstrom of this Station was called in as a consultant to advise in the conduct of the field study and the analysis of the study data. To this end Brandstrom spent about a month on detail at Crossett, Arkansas, and at the Station headquarters at New Orleans, Louisiana. Incidentally,

this trip gave him an opportunity to see the highlights of southern forestry developments and to get an insight into logging and forestry conditions in the South.

FOREST LAND ECONOMICS

New Public Domain - Western Oregon and Washington. Investigations conducted in western Oregon during 1936 show that counties have materially increased their "landed estates" since the original investigations of 1932 and 1933. This in spite of the fact that penalty charges and some of the interest charges were cancelled, lenient terms for payment of delinquent taxes were granted and tax foreclosures were postponed from time to time in a strenuous endeavor to stop the flow of reversion, and that easy instalment contracts were offered and other extra efforts were made to sell county lands to private purchasers. Within the areas studied, consisting mainly of forest lands, eight of the original nine sample counties increased their holdings from 283,900 acres in 1932-33 to 662,200 acres in 1935-36. The ninth sample county (Lincoln) has held no foreclosure since 1932. What will be the future rate of reversion? Right now it looks as though at least 3 acres were on the way to county ownership for every acre now in such ownership. The 1932-33 ratio of tax delinquent to county owned lands was better than 6 to 1.

It is to be expected that a large percentage of the total acreage in county ownership would be made up of recent cut-over, non-restocking lands, and coniferous stands usually under 6 inches in diameter, because lands such as these, giving little promise of early return

and costing money to hold, naturally would be dropped first by private owners, particularly during an economic depression when other supporting revenues evaporate and speculation has little on which to feed. Thus, we found that these classes comprised 253,500 acres or 38 percent of the total in county ownership. When, however, we found that conifers 6 inches and over in diameter, those of pole, tie and saw-timber size, made up 356,300 acres or nearly 54 percent of the county total, and that saw-timber size (conifers usually over 20 inches d.b.h.) alone made up 231,000 acres, we cannot help but ask ourselves again and again what underlies the break down of private forest ownership in this highly productive forest region.

Investigations continued in 1936 show that most of the Oregon counties have no program or policy for the long-term handling of these properties, other than to resell most of them, at any time, without cutting restrictions, to any private buyer often for less than the tax and interest charges against them. In addition to the depressing economic influences arising from pressure to sell in the present unwilling market in competition with distressed private owners--the taxpayers--are several adverse silvicultural influences which in time disrupt sound forest management and economic welfare. One of the most serious of these influences is sale by the county of timber of pole and tie size, which in this region is at the peak of its current growth, probably adding as much as 1,500 board feet per acre per year, with a correspondingly great quality increment.

To what extent have forest lands been blocked up into large operating units, from what ownership size classes do most of the lands

pass into county ownership and what bearing has size of ownership on difficulties in blocking out these tax-reverted lands into public forests? Trying to answer these questions we ran out, in 1936, the number of forest ownerships by six size classes within a forest area in Columbia County, Oregon, for the years 1928, 1932, and 1936. Farms were excluded from the count. Now one would expect and might assume that at least when timber became economically available small ownerships would have been consolidated into large and that few small ones would remain. But in Columbia, where logging operations are advanced, expectation and assumption were upset. Within this forest area, the 241,000 acres in private ownership were held in 1928 by 551 different persons: on an average, 486 persons owned 126 acres apiece; 44 owned 559 acres apiece; 14 owned 2,546 acres apiece; 6 owned 9,482 acres apiece; and 1 owned 62,614 acres. Of the area reverted for unpaid taxes between 1928 and 1932, 43 percent came from the 486 smallest owners, and 25 percent more came from the 44 next to the smallest owners. But between 1932 and 1936 the largest owners were the heaviest contributors. Between 1928 and 1936, 69,000 acres passed into county ownership. Nevertheless in 1936 there were still a large number of small private forest holdings scattered here and there over the sample area: 416 owned, on an average, 127 acres each, and another 33 owned 578 acres each. In addition, 6 owned 3,831 acres each; 4 owned 8,811 acres each; and 1 owned 42,169 acres.

With the passage of the Fulmer Act and the approach of State legislative assemblies, considerable pressure for service in outlining sound policies for remedial tax and land laws was brought upon members

of the section. The Station has contributed to the solution of the perplexing mature timber tax problem through the membership of the Director on the special tax committee appointed by Governor Charles Martin of Oregon. Aid was rendered in connection with improved assessment, tax delinquency, State acquisition, and rural zoning measures. Sponsors have hopes that the measures, even if not enacted into law, will be of immediate educational value.

Taxation. National forest contributions in lieu of taxes held the forefront in regional tax studies during the year 1936. Special studies were made in four representative counties, Lewis in western Washington, Lane in western Oregon, and Deschutes and Crook in eastern Oregon. In addition, considerable time was spent in analyzing criticisms of the deferred timber tax and other forest tax law proposals.

Planning Activities. The activities of the regional, State, and county planning boards threw an unusually heavy load upon the section. A tentative regional forest program was developed representing largely the viewpoint of the private owner and to some degree that of the public agencies. The section was called upon to aid in the detailed land economic surveys in Washington under the direction of Washington State College, and assisted the Resettlement Administration with generalized and preliminary land classification work in Snohomish and Grays Harbor Counties, Washington, and in Curry County, Oregon.

PUBLICATIONS AND DISSEMINATION OF RESULTS

The following material emanating from the Station was printed or distributed in multigraphed form during the year. In addition a number of manuscripts were prepared which will later be distributed; also there are many office reports recording the progress results of experiments which have not yet reached the publication stage. Much of the results of the Station's activities are disseminated through correspondence, personal contacts, and news releases. Members of the staff gave some 18 formal talks during the year at technical and general gatherings.

Papers Printed During the Year

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Johnson, H. M. Farm woodland has high value; coast area lists 2,796,616 acres of such land. Washington Farmer 61 (10): 21, May 14, 1936. (Also in Oregon Farmer, June 11 and Idaho Farmer, May 28, 1936.)

_____ Farms include valuable timber; products of woodlots worth millions. Washington Farmer 61 (14): 8, July 9, 1936. (Also in Oregon Farmer, July 23 and Idaho Farmer, August 6, 1936)

_____ Log prices by regions, west side Oregon, Washington, and British Columbia, 1919 to 1935, inclusive. Timberman 37 (9): 60-62, July 1936. (Also photostated)

Kirkland, B. P. & Brandstrom, A. J. F. Selective timber management in the Douglas fir region. Charles Lathrop Pack Forestry Found., 1936. 122 p. illus.

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Lodewick, J. E. Forest research and the pulp industry in the Pacific northwest. Pacific Pulp & Paper Industry, 10 (5): 24-26, May 1936.

_____ A study of annual lumber shipment and market location. Oregon State Planning Board, April 1, 1936. 8 p. charts & flow-maps.

McArdle, R. E. & Byram, G. M. An eye test for fire lookouts. Jour. of For. 34 (8): 794-796, August 1936.

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Morris, W. G. Photoelectric cell measurement of crown canopy density. Jour. of For., 34 (1): 52-53, Jan. 1936.

_____ Viability of conifer seed as affected by seed moisture content and kiln temperature. Jour. Agric. Res. 52 (11): 855-864, June 1, 1936.

_____ Unusual thunderstorm activity in the mountains of Oregon and Washington in 1935. Monthly Weather Rev. 63 (12): 348-349, Dec. 1935, and U. S. For. Serv. Service Bull. 20 (2): 2-3, Jan. 20, 1936.

Munger, T. T. How fast can we grow timber? Growth study plots tell their story. Timberman 37 (4): 13-14, Feb. 1936.

_____ Installment logging to reduce breakage. Timberman 37 (12): 26-28, Oct. 1936.

_____ Tongues in trees. Parks & Recreation 19 (11): 427-430, July 1936.

_____, Brandstrom, A. J. F. & Kolbe, E. L. Maturity selection system applied to ponderosa pine. West Coast Lumberman 63 (11): 33, 44, Nov. 1936. (Also as mimeograph "Basic considerations in the management of ponderosa pine forests by the maturity selection system" Sept. 1, 1936.)

Pacific Northwest Forest Experiment Station, Survey Staff. Forest type map, State of Oregon. (Northwest and southwest quarters.) 1936 ($1.00 for each quarter)

_____ Forest type map, State of Washington. (Northwest, southwest, and southeast quarters.) 1936. ($1.00 for each quarter)

Pacific Northwest Forest Experiment Station-Survey Staff. Forest statistics for the following counties:

Chelan County, Washington	May 25, 1936
Deschutes County, Oregon	May 18, 1936
Harney County, Oregon	May 7, 1936
Jefferson County, Oregon	Apr. 15, 1936
Kittitas County, Washington	June 20, 1936
Klamath County, Oregon	Feb. 1, 1936
Klickitat County, Washington	May 1, 1936
Lake County, Oregon	May 28, 1936
Walla Walla, Columbia, Garfield and Asotin Counties, Washington	Aug. 3, 1936
Wasco County, Oregon	March 1, 1936
Yakima County, Washington	April 1, 1936

Wilson, S. A., Kearns, R. S. & Judkins, D. H. Statistics on agricultural development in Washington. Sept. 1936. (Pacific N.W. For. Exp. Sta. and Wash. Agri. Exp. Sta. Misc. Joint Pub. no. 1)

APPENDIX - LIST OF CURRENT RESEARCH PROJECTS

The Current Research Projects in the Calendar Year 1936 of the Pacific Northwest Forest Experiment Station, exclusive of the Projects of Co-operating Local Agencies - the Forest Insect Field Station and the Office of Forest Pathology.

B-1	Phenology of forest trees and associated vegetation.
Fs	Genetic traits of various strains of Douglas fir and ponderosa pine seed.
Fn	Nursery practice for Pacific Northwest tree species.
Fp	Technique of out-planting, - including species, sites, and methods studies, and direct seeding.
Fp-Exotics	Adaptability of exotic species to the Pacific Northwest, including maintenance of Wind River Arboretum.
M-1	Silviculture of Douglas fir, particularly the silvical and protective aspects of partial cutting, as well as basic silvical study of the species and its associates.
M-1 Slash Disposal	Slash disposal in the Douglas fir, spruce-hemlock, and Port Orford cedar types.
M-2	Management and silvics of ponderosa pine, particularly effects of various types of selective cutting.
M-3	Management of the spruce-hemlock type, including basic silvics of these species.
M Red Alder	Silviculture and stand improvement of red alder.
Mt-1	Stand improvement in immature and overmature Douglas fir forests.
Mt-2	Stand improvement in ponderosa pine forests.
ME-1	Mensuration of Douglas fir type, including permanent plot studies of growth, yield, volume, and form in even-aged and in partially cut stands.
ME-2	Mensuration of ponderosa pine type, particularly yield of even-aged stands and regional growth of virgin stands.
ME-2	Growth cycles in ponderosa pine trees.

ME-3	Mensuration of spruce-hemlock, particularly growth of even-aged stands in the fog belt and permanent plot study of partially cut stands.
Pf-1	Techniques of fire prevention, detection and suppression, particularly fire-danger rating, visibility studies, and man-power production.
Pf-2	Factors which influence fire spread and behavior.
Pf-3	Fire damage, including effect of fire on stands of various kinds.
RR	Note: The new Range Studies program is not yet finally formulated.
RP L-260	Sawmill production studies at large pine and small Douglas fir mills.
RP-Woods & Mill Utilization	Investigations of methods for reducing woods and mill waste and bettering utilization practice.
RP-Species Studies	Utilization of minor species, especially the hardwoods of the Pacific Northwest.
RP-Special Studies	Miscellaneous studies and service tests of the properties, identification, utilization, and durability of local woods.
RE Statistics	Statistical studies of production, distribution, and prices of forest products, including the annual lumber, lath, shingle and log census in cooperation with the U. S. Bureau of the Census.
RE	The Forest Survey of the Douglas fir region (office work only).
RE	The Forest Survey of eastern Oregon and Washington.
RE	Tax delinquency and abandonment of forest lands.
RE	Contribution the national forests should make to local government in lieu of taxes.
RE	Application of land ownership and taxation studies to problems of land classification, rural zoning, and taxation.
RE	Financial aspects of forest management and exploitation in the ponderosa pine region.
RE	Economic aspects of selective logging in Douglas fir region.